Apparatus and method for the detachment of a tube blank from a support mandrel

The invention relates to a method and an apparatus for the detachment of a tube blank from a support mandrel according to the preamble of claim 1 or 8 and of claim 10 or 13, respectively. The method and the apparatus are suitable in particular for the detachment of a tubular air-spring blank from a support mandrel.

DE 27 50 6 42 C2 discloses a method and an apparatus for producing any desired blanks from elastomeric material, in which case, in order to remove a core, the product is put onto a carpet having a high coefficient of friction, and a longitudinal movement is superimposed on said carpet, preferably made of rubber grooved in the transverse direction. It is also described how the core, before the product is applied, can be covered with a suitable separating agent, such as a silicone solution for example, and how compressed air is introduced into the product in order to achieve a certain enlargement of the product.

DE 21 40 9 56 C3 describes an apparatus for producing elbow hoses on mandrels, in which apparatus an elbow blank is pushed onto the mandrel by means of a push cylinder. The push cylinder, which can be attached to the rear end face of the elbow blank in a pressure-tight manner, ensures that, when the elbow blank is pushed onto the mandrel, the air contained in the blank volume does not escape past the push cylinder but leads to an air cushion between the elbow blank and the mandrel, this air cushion facilitating the push-on operation.

Based on this prior art, the object of the invention is to provide an apparatus and a method with which tubular blanks of finite length can be easily separated from the support mandrel, so that quick further processing

of the blank and reuse of the support mandrel are ensured.

According to the invention, this is achieved by method having features of claim 1 or of claim 8 and by an apparatus having the features of claim 10 or 13.

By the insertion of a device for introducing a medium at one end of the support mandrel between the extruded blank and the support mandrel and by the injection or introduction of a medium by means of the device, an air cushion or film is deliberately achieved, as a result of which the blank, sticking to the support mandrel as a rule, is detached and a separating gap is produced, on account of which easy removal of the support mandrel is possible.

In order to ensure even and complete detachment of the blank, that end of the blank which is opposite the device is sealed off, or a second device is inserted between blank and support mandrel, so that the blank does not stick at a point or over a certain section of the circumference of the support mandrel. If the blank is sealed off at one end, for example by fitting a clip or a closure ring, the blank is completely detached up to the sealing point.

For easier detachment of the blank from the support mandrel, provision is made for liquid or powdery separating agents which assist or make possible easy separation to be added to the medium. The separating agents can be applied to the support mandrel before the fabrication of the tube blank, or the support mandrel is given a nonstick coating.

After the detachment of the blank from the support mandrel, provision is made for the latter to be pushed out by the medium, for example if the support mandrel

is partly formed as a hollow body and the medium accumulates in this hollow body, or for the support mandrel to be pulled out of the inflated and widened blank by an extraction device. The support mandrel is advantageously pulled out in an automatic or semiautomatic manner.

In order to prevent uncontrolled widening or partial widening of the blank, provision is made in an advantageous development for the blank located on the support mandrel to be inserted into a sleeve before the injection of the gaseous medium, this sleeve limiting the expansion of the blank, the inside diameter of the sleeve being at least slightly larger than the outside diameter of the blank.

In order to be able to introduce the medium at any desired location or also centrally inside the device, the device is fastened to the sleeve in such a way that the blank is clamped in place between the sleeve and the device, preferably in a sealing manner. In this way, it is possible to achieve complete detachment and separation of the blank from the support mandrel with only one feeding point for the medium.

To assist the detachment of the blank from the support mandrel, provision is made for a vacuum to be generated in the sleeve, in which case, as an alternative to the method of introducing a medium, such as, for example, air, water or oil, provision is made for the blank on the support mandrel to be sealed off from the sleeve and for a vacuum to be generated in the sleeve, so that the blank is separated from the support mandrel solely on account of the vacuum. To this end, it is necessary for means for the inflow of the ambient air to be incorporated in the bearing surface of the support mandrel, and provision is made for this, so that

separation from the support mandrel actually takes place.

An apparatus according to the invention provides for a device for introducing a medium at one end of the support mandrel to be arranged between the blank and the support mandrel, and for there to be feeding elements for introducing the medium between the blank and the support mandrel. A gap or a film is produced in a specific manner between support mandrel and tube blank by the apparatus, as a result of which said support mandrel and tube blank can easily be released from one another.

An advantageous configuration of the invention provides for a sleeve to be arranged around the blank, this sleeve being closed at least at one of its ends by the device, the blank advantageously being sealed off from the support mandrel at the other end, a factor which leads, on the one hand, to limitation of the radial expansion of the blank and, on the other hand, to complete detachment of the blank from the support mandrel. In addition, on account of controlled widening and by avoiding excessive expansion, the material is protected and quality improvement is achieved at the tube blank.

To ensure that the sleeve is reliably sealed off from the environment or from the device, provision is made for the device to be capable of being fastened to the sleeve, preferably via clamping cylinders, so that the device moves onto the support mandrel and in the process clamps the tube blank in place between it and the sleeve in a sealing manner.

In an alternative configuration of the apparatus, provision is made for a sleeve arranged around the blank to be provided with sealing elements for forming

an essentially airtight space together with the blank, a device being provided for generating a vacuum in the space formed by the sleeve and the blank, so that the blank is separated from the support mandrel on account of the vacuum. Advantageously provided in the support mandrel for this purpose are air-inlet arrangements which allow the ambient air to flow into a gap forming between the support mandrel and the tube blank.

To facilitate the manipulation of the bulky and heavy support mandrel, provision is made for the sleeve to be designed to be split or hinged in its longitudinal extent, so that the support mandrel together with the blank can be inserted into the swung-open sleeve and the latter can then be closed. It is of course also possible to design the sleeve in one piece, in which case the support mandrel must then be pushed into this sleeve.

In order to avoid sticking of the tube blank, preferably of an unvulcanized tube blank, to the inside of the sleeve, the latter is advantageously provided with a repellent coating, for example a PTFE coating.

In order to achieve certain preforming by appropriate widening during the introduction of the medium, a conical design of the sleeve is provided, which leads to different radii in the course of the longitudinal extent of the tube blank on account of different widening until the tube blank bears against the inside of the sleeve. Such a conical design of the tube blank is advantageous in particular for the production of air springs. In deviation from a conical design, the sleeve may have various geometries, such as, for example, multiple conicity or a corrugated shape, in order to permit corresponding adaptation of the blank to various intended uses. By inflation which varies in this way, adapted products from the preliminary materials shaped

cylindrically beforehand can be vulcanized in a subsequent processing step.

An exemplary embodiment of the invention will be explained in more detail below with reference to the attached figures. In the drawing:

figure 1 shows a side view of the apparatus;

figure 2 shows a front view of the apparatus with swung-open sleeve;

figure 3 shows a front view of the apparatus with swung-shut sleeve and fastened feeding device; and

figure 4 shows a detailed view of the apparatus according to figure 3.

Shown in figure 1 in a side view is an apparatus 1 in which a support mandrel 2 with an extruded tube blank 3 is inserted into a swung-open two-piece sleeve 4, consisting of a bottom part 4a and a top part 4b, the sleeve 4 being mounted on a frame 20. In the present exemplary embodiment, two apparatuses 1 are mounted back to back on the frame 20.

The sleeve top part 4b, relative to the sleeve bottom part 4a, is swung from the open position shown into a closed position via a lifting cylinder 6, the sleeve 4 being locked in the closed state and having an inside diameter which is greater than the outside diameter of the tube blank 3. The tube blank 3 comprises at least one rubber or plastic layer which has been applied to the support mandrel 2; however, the rubber mixture is preferably encased with strength members on the support mandrel 2 in order thus to obtain a thin-walled and robust tube blank 3. These strength members are, for

example, fibers, threads, wires or wovens or nonwovens. At the end of an extruder line, in which such a tube blank 3 is applied to the support mandrel 2, the support mandrels 2 are received at the end faces and are put into the sleeve 4 in order to be separated from one another there before the vulcanization.

The apparatus 1 according to figure 1 is shown turned through 90° in figure 2, in which it can be seen that the support mandrel 2 with the tube blank 3 is longer than the sleeve 4 and projects on one side, an attachment piece 7 designed as an extension element being arranged on the sleeve in the exemplary embodiment in figure 2 in order to permit easy adaptability to various production requirements. The support mandrel 2 projects from the sleeve 4 at the end faces on both sides, the sleeve 4, after the insertion of the blank 3 together with the support mandrel 2, being locked via a locking cylinder 5. Both the lifting cylinders 6 and the locking cylinder 5 preferably work hydraulically or pneumatically, although other working principles are possible and are envisaged.

Arranged on the left-hand end of the blank 3 is a device 10 for introducing a medium, which is pushed in between the support mandrel 2 and the blank 3 with its frustoconical end. To this end, the blank 3 has been manually released from the support mandrel 2 beforehand and widened in order to make it easier to push in the frustum of the device 10. In this case, the device 10 is designed in such a way that the end of the device 10 opposite the frustoconical end is closed. Also arranged on the device 10 are clamping cylinders 12, with which the device 10 can be clamped relative to the sleeve 4.

A clamped state of the device 10 relative to the sleeve 4 is shown in figure 3, in which the clamping cylinders 12 engage in a collar-like widening of the sleeve 4 and

pull the frustoconical portion of the device 10 toward the sleeve 4. In the process, overall, the support mandrel 2 is shifted to the right, as indicated by the arrow at the right-hand end.

The arrangement illustrated in Figure 3 is shown in the form of a sectional representation in Figure 4, in which, on the one hand, the clamping of the device 10 relative to the sleeve 4 via the clamping cylinders 12 and, on the other hand, the clamping of the tube blank 3 in place between the frustoconical end of the device 10 and the sleeve 4 become clear.

Furthermore, a feeding element 11 is arranged on that side of the device 10 which is remote from the frustoconical end, through which feeding element 11 the compressed air or another suitable medium such as water or oil can be introduced into the device 10.

As can be seen from the drawing, the support mandrel 2 is not completely hollow but rather has only one end-face bore for accommodating manipulating elements, so that, if a positive pressure is introduced via the feeding element 11, the medium can penetrate only between the blank 3 and the support mandrel 2 and thus detaches the blank 3. Bores, grooves or other passages be provided in the frustoconical end for simple introduction of the medium, in which case these bores, grooves or other passages are advantageously to emerge as close to the outside diameter of the support mandrel 2 as possible.

After the positive pressure has been introduced, the blank 3 will be widened until part of the outer surface touches the inside diameter of the sleeve 4. The medium is introduced until the blank 3 has been completely released from the support mandrel 2 over the entire length and the medium comes out at the other end, or

the support mandrel 2 is pushed out by the slight positive pressure. After complete detachment of the blank 3, the support mandrel 2 can be pulled out at the opposite end of the device 10; after complete removal of the mandrel, the device 10 is released from the sleeve 4, the latter is swung open and the blank 3 can be removed.

In order to avoid sticking of the blank 3 to the inside of the sleeve 4, the latter is given a nonstick coating, for example it is wetted or smeared with PTFE and/or with a separating agent which prevents sticking.

In addition, liquid or powdery substances can be introduced with the medium in order to facilitate detachment; and provision is likewise made for that end of the blank 3 which is remote from the device 10 to be sealed off in order to build up a pressure between the support mandrel 2 and the blank 3. By a special configuration of the sleeve 4, various outside diameters of the tube blank can be pre-expanded in order to facilitate further processing of the tube blank 3.

In addition to, or as an alternative to, the detachment and the removal of the tube blank 3 from the mandrel via compressed air, provision is made for this to be assisted or replaced via a vacuum process, in the course of which the intermediate space between sleeve 4 and tube blank 3 is sealed off and a vacuum is generated. Depending on requirements, different tube blank lengths can be processed via the extension elements 7.